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Chapter 3

Farmers' Vulnerability to Climate Change Impacts in Semi-arid Environments in Tanzania: A Gender Perspective

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Additional information is available at the end of the chapter

http://dx.doi.org/10.5772/intechopen.72108

Abstract

This chapter reports on the study conducted in semi-arid environment in Iramba and Meatu districts to examine gender vulnerability and adaptations to climate change impacts. The study adopted qualitative approach that brought together smallholder farmers and agro-pastoralists to discuss issues, in nine focus group discussions, in three villages. A total of 99 participants were involved. The results showed that the major climatic hazards since 1985 were, among others, drought, floods, strong wind accompanied with "ice falling," and crop and livestock diseases including malaria and cholera that affected humans. Their frequencies were reported to be on the increase, especially since the 2000s. Such hazards negatively affected livelihoods resources like land, livestock, human and water resource that in turn affected communities' livelihoods. Men and women had developed different coping and adaptation strategies, which had not changed much in the past 30 years. Men's strategies were related to mobility contrary to women counterparts. The chapter concludes that women and children were more vulnerable due to factors like limited control over livelihoods resources, limited mobility, domestic chores and the general subordinate position in the communities. Concerted integrated programmes from various stakeholders are required to rectify an existing situation.

Keywords: vulnerability trends, climate change, community livelihoods

1. Introduction

In Tanzania, vulnerability to climate change impact jeopardizes development efforts through directing available resources to reducing or curbing short-term and long-term impacts. The body of literature on climate change has increased considerably since the 2000. Some writers including Nombo et al. [1] have reported climate change impacts that are differentiated by gender. However, gender vulnerability is not sufficiently explored. The concept of vulnerability to climate

change is viewed to include outcome vulnerability that connotes outcome of climate change impacts as adopted in this chapter. It is also taken as contextual vulnerability that is a response of climate – society interactions [2]. In view of the outcome vulnerability, scholars consider the outcome of exposure to the stimuli, sensitivity and adaptive capacity [3, 4]. Others take vulnerability to climate change impacts as a degree to which one is susceptible to the negative impacts or the extent to which climate change damage or harm a system [5]. In line to this understanding, the author of this chapter contend that when adaptive capacity is low and when coping and adaptation strategies to climate change impacts are not working effectively due to gender inequality, among other factors, the phenomenon compromises livelihoods resources and community livelihoods, more generally.

Literature demonstrates different models of disaster risks that are used to assess vulnerability including, among others, pressure and release and access model [6] and CARE International climate vulnerability and capacity analysis model. The CARE's model helps to understand implications of climate change for community livelihoods, including identification of the most vulnerable social groups that capture dimensions of local adaptation and coping strategies [7]. To that effect, this model is suitable for analyzing vulnerability with a gender perspective. The pressure and release model views vulnerability as a progression from root causes, to the processes or activities that transform the root causes into particular forms of insecurity and finally into unsafe conditions. Root causes include limited access to power, structures and resources. They also include limited access to political and economic systems. It appears that, although some models like the CARE's model put gender as an "add on" component; existing vulnerability to climate change models are gender blind.

It is worth noting that vulnerability assessment is vital for households and communities whose livelihoods depend on natural resources that are sensitive to climate change impacts. Since gender dimension is critical for development, vulnerability assessment with a gender lens is also critical because gender inequality is prominent in Sub-Saharan Africa (SSA) and particularly in Tanzania relative to other regions in the world [8]. Literature shows that community livelihoods in semi-arid environments, like in Iramba and Meatu in Tanzania, are more at risk of being affected by climate change impacts because of high dependence on rain-fed crop production and livestock keeping, which are both sensitive to the phenomenon [9, 10].

Smallholder farmers and agro-pastoralists in semi-arid environments in developing countries like Tanzania are characterized by poor living conditions manifested through low household income, food insecurity, inadequate health services, unstable energy supplies, and fragile natural ecosystem. This prevailing condition exacerbates farmers and agro-pastoralists' vulnerability to the climate change impacts [7, 11]. As such, there is a growing concern that women are more vulnerable to the impact relative to men counterparts because of unequal gender relations, which tend to downgrade women in the sphere of access to and control over resources that can assist coping and adaptation measures [1, 8, 11, 12]. Women exclusion in decision-making and planning for adaptation measures may exacerbate the problem [11, 13, 14].

This chapter acknowledges the fact that women are "agents of change" for designing gender sensitive adaptation policies to address climate change impacts, thus reducing gender vulnerability [15]. However, available studies on vulnerability to climate change impacts including Kelly and Adger [5], O'brien et al. [2] and Coletti et al. [3] do not address gender dimension

squarely from methodological point of view to the outcomes. This information is critical because different gender groups have different adaptation and coping strategies and also different ability to adapt to climate change impacts, hence different vulnerability. For instance, while men consider migration as a strategy to reduce vulnerability, it is likely to increase vulnerability among women who have limited mobility particularly in rural communities [16].

1.1. Analytical framework

The key concepts in this chapter are: gender vulnerability, climate change and livelihoods. A concept like climate change is seriously conceptualized in the literature as a long-term mean statistics of weather [4, 9]. This study takes climate change as any long-term change in rainfall and extreme weather events like drought and floods. In addition, livelihood is conceptualized in this chapter to include possession of human capabilities like education, skills and health; access to tangible and intangible assets and existence of economic activities [17, 18]. The concept is essentially about how different people in a community live, what resources do they depend and what activities do they undertake to sustain their living. Gender vulnerability, therefore, considers complex relations between men and women in a community and how these relations result into unequal vulnerability between men, women and children [14].

This chapter puts livelihoods at the center of the communities to understand how people live and what resources and activities do their livelihoods depend. It picks some elements of the CARE's model [7] named as CAREs' climate vulnerability and capacity analysis model. This helps to understand implications of climate change impacts on community livelihoods, and also helps to identify the most vulnerable social groups including dimensions of local adaptation, which involve anticipating, planning and acting to reduce vulnerability; and coping strategies, which involve the use of available skills, resources and opportunities to address, manage and overcome short-and medium-term vulnerability, though can, in the long-term increase vulnerability [7, 19].

The chapter adopts some elements of the Sustainable Livelihood Approach (SLA) developed by DFID [20] in understanding how livelihoods assets and outcomes are affected by the vulnerability context like shocks, trends and seasonality of climatic and non-climatic hazards. The livelihoods assets include human, social, financial, natural and physical capital, which when negatively affected by vulnerability hazards translates into increasing community vulnerability by affecting food security, income, and natural resource base, hereunder also named livelihoods resources like land and water. The analysis of community vulnerability, with a gender lens, due to the long-term climate change impacts and other stressors in the context of SLA assist answering questions like "how community livelihoods, men and women, are affected by climatic and non-climatic hazards, which forms the vulnerability context of the livelihoods assets." The analysis also explores gender differential vulnerability by looking at types of coping strategies and ability of men and women to cope or adapt to the climate change impacts.

2. Study areas

The study was conducted in Iramba and Meatu districts. Iramba is found in Singida while Meatu is found in Simiyu Region. Both districts lie entirely in semi-arid environments, which

are prone to droughts and other manifestations of climate change. The districts were selected for the study because poverty, defined as the inability to meet a minimum standard of living, is as high as 80% [1] suggesting that the districts were likely to be vulnerable to the climate change impacts [4, 7]. Being contiguous, the two districts were good for assessing differences in terms of manifestation of climate change and gender vulnerability to the phenomenon for the two communities: the Wasukuma in Meatu and the Wanyiramba in Iramba.

The mean annual rainfall in Meatu ranges between 400 mm and 900 mm in the southern and northern parts respectively [21]. In Iramba, the mean annual rainfall ranges between 500 mm and 850 mm and the surface temperature ranges between 15°C in July and 30°C in October [22]. The rainfall regime in both districts is unimodal, which starts in November and ends in April [23]. In Meatu, vegetation is mostly shrub and thorny trees scattered or clustered in some parts while Iramba's vegetation include Miombo woodlands, acacia woodlands and grasslands [24]. Three villages were involved in the study: Mwamanimba and Mwashata in Meatu and Kidaru in Iramba. The two villages in Meatu are dominated by the Sukuma while Kidaru in Iramba is dominated by the nyiramba. All villages in the study areas are dominated by the smallholder farmers. Mwamanimba is dominated more by agro-pastoralists whose livelihoods rely on rainfall. This means that any change in rainfall is likely to affect livelihoods. Since smallholder farmers and agro-pastoralists are poor in the study areas [1], it was anticipated that they are likely to be vulnerable to climate change impacts.

3. Methodology

This chapter adopts qualitative approach to research as emphasized by Chambers [25] and Creswell [26]. Data were collected from smallholder farmers and agro-pastoralists using focus group discussions (FGDs). **Table 1** shows villages, number of FGDs, their size [27] and age of participants involved. There were separate groups for men, women and youth for each tool used to collect data in each village to get insights from different gender groups. The United Republic of Tanzania (URT) in its National Policy of Youth Development [28] defines youth as those whose age is within a range of 15–35 years. During FGDs, the study employed historical time line to assess trends and frequencies of vulnerability hazards related to climate change and those that are non-climatic hazards. Three time lines were established, one for each gender group: men, women and youth. This method also helped to get insights about past hazards and their changes in the previous 30 years since 1985. It also helped men and women to make sense of the trends of the hazards and changes over time. Special attention was given to major hazards and their effects, changes in land use and land cover, changes in food security and major political events like local governments and national elections. Adaptation and coping strategies, their changes and effectiveness, were also assessed.

Secondly, the study used seasonal calendar to identify periods of stress, famine and vulnerability, to understand livelihoods and coping strategies, to analyze changes in seasonal activities, and to evaluate how vulnerability varied seasonally between men and women. Other

Village name	Number of FGDs conducted	Number of men participants	Number of women participants	Number of youth participants	Mean age (years)	Minimum age (years)	Maximum age (years)
Kidaru	3	11	12	11	49	30	75
Mwashata	3	12	10	12	54	39	76
Mwamanimba	3	10	10	11	44	20	73
Total	9	33	32	34	—	—	—

Table 1. Information on FGDs and participants involved.

things analyzed using this tool include time for leisure and traditional dances, planting and harvesting periods, periods of food and income insecurity, timing of hazards like droughts and floods and seasons for illnesses. Thirdly, vulnerability matrices were used to determine hazards, which have the most impacts on livelihoods resources. Livelihoods resources are defined, in this study, as those resources considered most important by smallholder farmers and agro-pastoralists in supporting livelihoods. Participants were asked to prioritize four important livelihoods resources. The matrices also helped to determine the most vulnerable livelihoods resources and to identify adaptation and coping strategies used, and whether the strategies to address the hazards had changed over time. Participants were also asked to decide on the degree of impact of each hazard against the livelihoods resources. The score for a significant impact was 3, for medium was 2, for low was 1 and zero was for no impact. During data analysis, information for each gender group was put together based on similarities and differences between gender groups.

4. Results and discussion

4.1. Trends in hazards causing vulnerability

Tables 2–4 present historical events of the hazards reported by men, women and youth during FGDs. The results show that drought, floods, strong winds, human and livestock pests and diseases, crop pests and diseases were hazards related to climate change that affected community livelihoods. Non-climatic hazards mentioned include low and fluctuation of price for agricultural produce and livestock, robbery of livestock, killings of people with albinism, and tribe wars between the Sukuma and the Taturu. These need to be addressed in order to achieve sustainable livelihoods in the communities. In order to justify these results, FGD participants reported the following:

> *"…Drought…we have lost hope at this point…when it rains, it is so windy…already it has destroyed 15 to 30 houses between January and February this year…the building of the primary society has been destroyed by a strong wind…the cemetery has also been destroyed by floods causing reburying of some bodies…" (Women FGD participants, Mwashata, March 2015).*

Another quotation is:

> *"…El-Niño: It rained about 6 times a day in 1998…there were a lot of crop pests in bulrush millet and cotton. Rats destroyed sweet potatoes. Harvesting of bulrush millet before maturity was necessary to avoid a complete loss…" (Men FGD participants at Kidaru, March 2015).*

Another quotation is:

> *"…In 2002, heavy rains accompanied by 'ice falling' destroyed sweet potatoes and other crops. Fungal diseases, cholera, and malaria became common for humans in that year…" (Women FGD participants at Mwamanimba, March 2015).*

Those quotations inform that farmers especially women had lost hope because of extreme weather events like drought, el Niño rains accompanied by strong winds and ice falling. In addition, killings of people with albinism, which rarely happened in the past, especially in the Sukuma communities of Meatu, were also reported indicating that they were becoming one of vulnerability hazards. Respondents associated killings with national elections because they increased during those periods. The hazards reported by men, women and the youth were almost similar suggesting that all had knowledge about previous and present hazards as shown in the quotations and in **Tables 2–4**. Inspite of the hazards that happened, some years, especially since 2000, were good as justified in the following quotation:

> *"…In 2007, we had all good times, there is nothing we did not do in this year because it was a very good year, we had plenty of food and money, we were drinking and having all the fun…" (Men FGD participants at Kidaru, March 2015).*

It appears that most of the major hazards affecting livelihoods were related to climate change although non-climatic hazards were also concerns. Interestingly, non-climatic hazards were indirectly linked to climate change, which in turn exacerbated poor livelihoods. Tribal wars, for example, were linked to difficulties in making livelihoods aggravated by drought, and therefore causing theft of livestock by the Taturu to the Sukuma communities. This triggered the tribal wars. Similarly, price fluctuation of agricultural produce was attributed to poor productivity resulting from extreme weather events and changes in rainfall patterns. Killings of people with albinism were also attributed to difficulties in making a living in addition to cultural beliefs that albino body parts are sources of wealth. This implies that climate change manifested through, among other things, drought and changes in rainfall patterns, was the major vulnerability hazard having direct and indirect impact to communities' livelihoods.

Tables 2–4 also show frequency of hazards. Drought, that caused famine for example, occurred about 8 times in the previous 15 years since the 2000. A careful look at **Tables 2–4** shows that drought frequencies and famine had increased over time. Natural events, like earthquakes, lightening that kills people, and "ice falling" when it is raining occurred in the previous 15 years. These exacerbated vulnerability of communities' livelihoods. It appears that those natural hazards rarely happened in the 1990s and beyond (**Tables 2–4**). In addition, drought frequencies, strong winds, human and animal diseases and other manifestations of climate change are likely to increase in the future. This leads to the argument that communities' livelihoods are likely to

Year	Events
2015	Drought
2014	Good year with enough rainfalls though accompanied by strong winds in November that damaged houses. Heavy rains occurred in March. There were enough harvests and pastures. Participated in electing local government leaders
2013	Famine, price of cereals went up to TAS 15,000 per cane. Livestock died. People survived by exchanging livestock for cereals. Some survived by a single meal.
2012	Heavy rains and floods
2011	Drought and famine (Kidaru had only three rain days throughout the year)
2010	Drought (At Mwashata village, there were good rainfall and good harvest this year)
2009	Drought and Cholera eruption – Mwamanimba was different, it was a good year, harvests were good and there were about 20 weddings
2008	Enough rains and good harvests, but strong winds damaged houses while pests like rats damaged crops and stored cereals
2007	Good year with enough rains
2006	Famine, rains started in February and livestock died
2005	There was drought and famine (bad year)
2004	This was a local government election year. Cholera eruption. Rains were moderate, but in Mwamanimba there was shortage of pastures for the livestock
2003	Rain stopped before crop maturity
2002	Drought and famine
2001	Enough rains and harvests
2000	Election and census year, killing of people with albinism and there was drought and famine
1999	Famine called *tonja* in Meatu, caused by el-Niño rains that occurred in 1998. Pests destroyed sorghum and millet at an early stage, livestock died. The father of the nation J.K Nyerere also died this year
1998	El-Niño rains. It rained about 6 times a day. A lot of crop pests in millet and cotton. Rats destroyed potatoes. Harvesting before full maturity was necessary to avoid a complete loss
1997	Enough rains
1996	Enough rains and good harvests of bulrush millet especially in Kidaru (*Mwaka Dosa* means a year with bumper harvests), but pests destroyed paddy and millet
1995	Drought and famine. In Mwamanimba, about 30 families migrated to Dodoma, Maswa, Morogoro, Mbeya, Manyoni and Sumbawanga
1994	Famine
1993	Good year because of good harvests (Mwaka Nsumba/Nsoga)
1992	Good year because of good harvests (Mwaka Nsumba/Nsoga)
1991	Was a moderate year (Not so good not so bad)
1990	Good rains, good harvests (good year)
1989	Drought and famine, livestock died and cholera erupted
1988	Drought and livestock died
1987	Good year and harvests
1986	Was a good year
1985	Famine because of war between the Sukuma and the Taturu

Table 2. Trends of events reported by men.

Year	Events
2015	Drought: crop failure, livestock emaciation due to lack of pasture
2014	Good rains, good pastures, but an earthquake occurred and destroyed some houses in Mwashata village
2013	No enough rains, some families migrated to other areas (out of the regions in Tabora). Some men left their families and never came back
2012	Good rains and good harvests
2011	Not so good not so bad year
2010	National election year, a war between the Sukuma and Taturus occurred because the Taturu were stealing livestock in the Sukuma communities. There were strong winds that destroyed houses. There was also poor harvests resulted into famine
2009	Drought and famine. People survived by eating wild food and fruits
2008	Good rains and good harvests, some houses were destroyed by strong winds. Pests also destroyed crops
2007	Good rains and good harvests
2006	Famine. Lightening occurred and they killed some people and livestock
2005	National election year, drought and famine year (*labhalabha*), 20 kg of maize sold 18,000 Tshs (bad year)
2004	Not so good not so bad year in terms of rains and harvests
2003	Famine. Some men left their homes and never come back. About 15 men abandoned their families (wives and children) all together. Some women opted 'sex for money and food' to rescue children
2002	Heavy rain accompanied by ices falling destroyed potatoes and other crops which were still in the farm. Human diseases like small pox, malaria and polio occurred especially to those families which ignored vaccination
2001	Good rains and good harvests
2000	National election and census year, drought and famine, rift valley fever erupted and trachoma
1999	Drought and famine, men moved in search of food and jobs to earn an income, livestock died
1998	Eli-Niño destroyed crops and houses. Eruption of crop pests that destroyed millet, cotton and maize, Rats also damaged potatoes
1997	Eli-Niño came, it caused huge damage on crops
1996	Good rains, good harvests
1995	There was national election
1994	Famine. Some men left their families (wives and children) and never came back. Some of the women who were left by their husbands decided to get married by other men so that they can be assisted to raise their kids
1993	Was a good year (Mwaka Nsumba/Nsoga)
1992	Was a good year (Mwaka Nsumba/Nsoga)
1991	Not so good, not so bad year
1990	There was a human fungal disease which affected adults and children. About five people died. People used traditional medicine until when vaccines were brought in the dispensaries especially in Mwamanimba.
1989	Drought and famine, cholera also erupted
1988	Drought, livestock died
1987	This was a good year because of good rains and good harvests (Mwaka Nsoga)
1986	Was a good year
1985	Famine because of a war between the sukuma and the taturu that occurred in 1984

Table 3. Trends of events reported by women.

Year	Events
2015	Drought: crop failure, livestock emaciation due to lack of pasture
2014	Good rains, good pastures, but an earthquake occurred and destroyed some houses in Mwashata village
2013	No enough rains, some families migrated to other areas (out of the regions in Tabora). Some men left their families and never came back
2012	Good rains and good harvests
2011	Not so good not so bad year
2010	National election year, a war between the Sukuma and Taturus occurred because the Taturu were stealing livestock in the Sukuma communities. There were strong winds that destroyed houses. There was also poor harvests
2009	Drought and famine. People survived by eating wild food and fruits
2008	Good rains and good harvests, some houses were destroyed by strong winds. Pests also destroyed crops
2007	Good rains and good harvests
2006	Famine and lack of pasture. Several lightening occurred and they killed some people and livestock
2005	National election year, drought and famine year (*labhalabha*), 20 kg of maize sold 18,000 Tshs (bad year)
2004	Not so good not so bad year in terms of rains and harvests
2003	Famine. Some men left their homes and never come back. About 15 men abandoned their families (wives and children) all together. Some women opted "sex for money and food" to save children
2002	Heavy rain accompanied by "ice falling" destroyed potatoes and other crops which were still in the farm. Human diseases like small pox, malaria and polio occurred especially to those families which ignored vaccination
2001	Good rains and good harvests
2000	National election and census year, drought and famine, rift valley fever erupted and trachoma
1999	Drought and famine, men moved in search of food and jobs to earn an income, livestock died
1998	Eli-Niño destroyed crops and houses. Eruption of crop pests that destroyed millet, cotton and maize, Rats also damaged potatoes
1997	Eli-Niño came, it caused huge damage on crops
1996	Good rains, good harvests
1995	There was national election and famine
1994	Famine: Some men left their families (wives and children) and never came back. Some of the women who were left by their husbands decided to get married by other men so that they can be assisted to raise their kids
1993	Was a good year (Mwaka Nsumba/Nsoga)
1992	Was a good year (Mwaka Nsumba/Nsoga)
1991	Not so good, not so bad year
1990	There was a human fungal disease which affected adults and children. About five people died. People used traditional medicine until when vaccines were brought in the dispensaries especially in Mwamanimba.
1989	Drought and famine, cholera also erupted
1988	Drought, livestock died
1987	This was a good year because of good rains and good harvests (Mwaka Nsoga)
1986	Was a good year
1985	Famine because of a war between the sukuma and the taturu that occurred in 1984

Table 4. Trends of events reported by the youth.

become more vulnerable in the future especially if smallholder farmers are unable to cope with, or if the coping strategies are not working effectively, and or, if concerted government efforts are not fully integrated in the development programmes to minimize vulnerability.

4.2. Gender vulnerability and seasonality

Table 5 presents seasonal responsibilities by a gender lens. The results show that men, women and youth were involved in agricultural activities. Control and grazing of livestock especially cattle were under men's domination, which is common for most of agro-pastoralist communities with a few exceptions like in Iramba where control was shared between men and women. **Table 5** also shows that women were more responsible for most of agricultural based livelihoods activities relative to their men counterparts, though control over land was under men. This is also common in many agricultural communities in Africa. Seasonal responsibilities differed between men and women. Unlike men, women were busy throughout a year. For instance, in addition to domestic chores, women after farming period engaged in slicing and drying potatoes, collecting and drying wild vegetables and firewood, and participating in weddings. The knowledge of environmental management among women is therefore critical for sustainable management of natural resource base. The opposite may result into environmental degradation that can increase vulnerability to women. For that matter, women have less leisure time compared to men although they played pivotal roles regarding communities' livelihoods. Thus, women were more vulnerable because of increasing time and labor to collect water and firewood, a situation that was aggravated by climate change impacts.

Men spent most of the time for participating in traditional dances and visiting relatives and friends especially between April and September (**Table 5**). This is because, for a good year, harvesting started in April and therefore adequate food was available up to September each year. Thus, communities did not worry about food shortage and food insecurity during that particular period. Therefore, men used that period for leisure, particularly going out of their communities for traditional dances, leaving all responsibilities at home like fetching water and chopping firewood for women and children. Traditional dances that involved men's movements out of the communities happened during both, good and bad years. Youth, especially boys, also spent April to September period, among others, for participating in football league, traditional dances, and for taking livestock to the areas where they could get enough pasture and water (**Table 5**).

Participants reported that communities' vulnerability was high during December, January, February and sometimes March. Vulnerability was highest in January and February because of lack of income, and food insecurity (**Table 5**). In that period, food and income insecurity occur concurrently with dry spells, droughts, high incidence of human diseases like malaria and cholera ([24]; Synneva G et al., [29]) and therefore exacerbating vulnerability. That was also the period for men taking livestock to graze in conserved areas due to lack of grazing areas and water in some villages. In addition, women who were left behind coped by borrowing food or money from friends and relatives to be repaid sometimes later. Truancy among school children increased with vulnerability especially for girls who had to assist their mothers on off-farm activities. It is clear that climate change particularly drought is linked to vulnerability of communities' livelihoods. Those owning livestock, though price of livestock was low

Month	Performed by men	Performed by women	Performed by youth
January	Tilling the land and planting, but no money and enough food	Tilling the land and planting	Tilling the land, weeding, planting and grazing livestock for the men
February	Weeding, but no money and enough food. Normally there is a dry spell of 1 month or more	Weeding. Dry spell	Weeding. Dry spell
March	Harvesting. Floods may occur	Weeding and sometimes harvesting. Floods may occur	Planting and weeding. Floods may occur
April	Harvesting and traditional dances begin. Floods may occur	Harvesting, drying vegetables for future use	Harvesting, Drying vegetables and preparation of building poles
May	Harvesting, traditional dances, digging water holes for cattle's watering points, bricks making and preparing post-harvest storage devices	Harvesting, drying vegetables, slicing potatoes and chopping firewood	Harvesting, football league begin especially for men, slicing of potatoes, preparing bricks, and scaring of bird in the paddy fields. Taking livestock to conserved areas at Mwamanimba
June	Traditional dances (leisure time) and harvesting through traditional self-help groups. Return of livestock from conserved areas at Mwashata	Slicing potatoes, making baskets using local materials, harvesting of agricultural produce	Slicing of potatoes, harvesting and processing through traditional self-help groups and preparation for marriage
July	Traditional dances, building houses, harvesting and transportation of agricultural produce	Slicing potatoes, making and selling local brew especially in Iramba and harvesting of cotton	Slicing of potatoes, making bricks, houses construction, harvesting, football league and doing small scale businesses
August	Traditional dances, visiting relatives and friends, harvesting, processing and storage, brick making and construction of houses	Chopping firewood, visiting relatives and friends, participating in weddings, traditional dances and drinking local brew	Visiting relatives and friends, houses construction, traditional dances, weddings, drinking local brews and football league continues
September	Traditional dances, construction of houses	Chopping firewood and gardening near the river banks	Seasonal movement of livestock, houses construction, and football league
October	Preparing farms, finalizing traditional dances, construction of houses	Copping firewood, farm and seed preparation, and gardening near the river banks	Football league continues, doing small scale businesses, and farm preparation
November	Start of wet season. Farming starts especially tilling the land and planting	Farm and seed preparation, and gardening near the home steads and in the fields afar	Tilling the land with a plow, and planting of maize and cotton
December	Tilling the land and planting. Livestock taken to conserved areas at Mwashata and Kidaru	Tilling the land, planting and gardening near the home steads and in the fields afar	Tilling the land, planting and weeding. Return of livestock from conserved areas at Mwamanimba

Table 5. Seasonal responsibilities.

during food and income insecurity months, could sell to earn income for food to cushion vulnerability. However, dependence on livestock for food and income, in communities like the Sukuma in Meatu where livestock and income are controlled by men, may not help much unless interventions are done to address men's mobility when vulnerability is at the peak. Even though, households without livestock felt the pinch most. The chapter therefore argue

that the periods of food and income insecurity were the periods of stress, food insecurity and vulnerability, more so among women and children. June and July were good months because communities had adequate food and income obtained from agriculture and selling agricultural produce respectively especially during good years.

4.3. Gender, hazards and livelihoods resources

Tables 6–8 present livelihoods resources up on, which communities' livelihoods depended and the degree of impact that each of the vulnerability hazards had on each of the livelihoods resources. Livelihoods resources are those resources, considered by the communities, most important in making livelihoods. In this chapter, they include agricultural land; water sources mainly rivers, livestock and institutions like schools and dispensaries. Interestingly, men, women and youth reported similar major vulnerability hazards that affected livelihoods resources (**Tables 6–8**). Reflections in FGDs showed that although non-climatic factors were also concerns, the major vulnerability hazards were climatic factors like drought, floods, strong winds, and human, crop and livestock diseases. These were widespread such that, once happened; there were no safe places in the communities. In other words, the hazards affected everybody although differently depending on gender, ability to cope and households' adaptive capacity.

	Land/farms (natural capital)	**Livestock (natural capital)**	**Water sources, e.g., rivers (natural capital)**	**Institutions, e.g., schools (physical capital)**
Drought	3	3	2	3
Flood	3	2	0	3
Livestock diseases	1	3	0	0
Human diseases	3	1	0	3
Plant insect pests and disease	3	1	0	2

Note: 3 = significant impact on the resource; 2 = medium impact; 1 = low impact and 0 = no impact.

Table 6. Impact scores of vulnerability hazards reported by men.

Hazard	**Land/farms (physical capital)**	**Children (human capital)**	**Water sources, e.g., rivers (natural capital)**	**Institutions, e.g., schools (physical capital)**
Drought	3	3	2	3
Floods	2	2	0	1
Human Diseases	2	3	2	3
Strong Winds	2	2	0	1

Note: 3 = significant impact on the resource; 2 = medium impact; 1 = low impact and 0 = no impact.

Table 7. Impact scores of vulnerability hazard reported by women.

Hazard	Land (natural capital)	Water sources, e.g., rivers (natural capital)	Livestock (natural capital)	Institutions, e.g., schools (physical capital)
Drought	3	3	3	3
Strong winds	0	0	2	3
Human diseases like cholera and malaria	0	0	0	3
Crops pesticides	1	2	3	3

Note: 3 = significant impact on the resource; 2 = medium impact; 1 = low impact and 0 = no impact.

Table 8. Impact scores of vulnerability hazards reported by youth.

Synthesis with FGD participants showed that drought occurred at any point in time during wet seasons while floods occurred normally during March and April, but could also occur at any point in time during wet seasons. The wet season started in October/November and ended in April/May [24]. Prevalence of cholera and malaria was high in wet seasons. In most cases, occurrence of the climatic hazards was difficult to predict. Each of the hazards negatively affected livelihoods resources. The impact manifested through crop failure and lack of pasture that definitely caused food insecurity and famine. The aggregate impacts of the climatic hazards affected women most than men because control over livelihoods resources, that are critical for coping and adaptation to climate change impacts like livestock and land, is under men domination [1]. In addition, men's mobility reduced their vulnerability relative to women counterparts implying that women were more vulnerable to the impact. This implies that although mobility helped men to survive against climatic impacts it aggravated vulnerability among women and children.

A synthesis in FGDs showed that drought affected land through soil degradation, which, like soil erosion, contributed to loss of soil fertility that eventually resulted into crop failure and poor crop production. It also contributed to lack of pasture, and drying up of water bodies like rivers. That means drought affected natural capital in the communities. The ultimate impact of the hazards was famine that, among others, negatively affected school attendance among pupils. In that way, famine affected human capital among women and children. Human diseases like cholera and malaria, affected human capital and labor force in agriculture and livestock, while livestock diseases affected animal power and agricultural production. Generally, human, crop and livestock diseases had effect on financial capital through reduced production and productivity and increasing cost in controlling them.

Strong winds destroyed human shelters and public buildings like classrooms and therefore had effect on physical and human capital as well. Focus groups commented that when classrooms were damaged by a strong wind, pupils' attendance among boys and girls was affected as well as the learning process. Girls were likely to be more affected because of their subordinate position in agricultural and agro-pastoralist communities. Girls' subordination is common in most rural areas in Africa [1]. We therefore argue that the poor learning process caused by lack of classrooms as a result of climatic hazards had negative impact on aggregate human capital, which is critical for improving communities' livelihoods. If this trend continues,

vulnerability to climate change impacts is likely to aggravate in the future. Some development partners especially World Vision Tanzania (WVT) had intervened through "food provision" to the pupils at school. Yet, this may not be enough because the intervention is likely to be not sustainable. Therefore, other policy interventions, that can ensure sustainable food security, have to be in place to overcome the situation.

Men and women reported serious impact of drought on land, livestock and school institutions. Similar climatic hazard was report to have medium impact on water resource. Floods had serious impact on land and school institutions. Diseases had serious impact on land, livestock and school institutions (**Table 6**). Women reported serious impact of human diseases on children and school institutions (**Table 7**). In addition, youth reported serious impact of drought on land, livestock, water resource and school institutions. They also reported serious impact of strong winds and human diseases on school institutions, and crop insect pests and diseases on livestock and school institutions (**Table 8**). This shows interaction between the climate change and livelihoods.

4.4. Gender adaptation and coping strategies against hazards

Discussions in focus groups showed that men and women had adopted various strategies to cope with hazards like droughts and their outcomes including famine, lack of pasture, crop and diseases and pests. For instance, the whole family could permanently migrate to other regions in the country, where it was perceived to be receiving adequate amount of rainfall, or where there was no drought, and that the region is suitable for agriculture - in terms of land availability and fertility - and livestock keeping. Those areas include some parts of Tabora, Mbeya, Morogoro, Geita and Rukwa, to name a few. To justify migration men's FGD participants at Mwamanimba reported the following:

> *"…in 1995, about 30 families out-migrated to Tabora, Morogoro, Mbeya and Sumbawanga, and from that time to date almost half of the households in the village has permanently migrated…" (Men FGD participants at Mwamanimba, March 2015)*

Based on that quotation, the 1995 was a dry year accompanied by famine that caused permanent family migration especially at Mwamanimba in Meatu. Since then, more families had permanently migrated responding to an increased frequency of drought in the 2000s. Surprisingly, other families migrated into the same village suggesting that vulnerability due to climate change is complex and widespread. In addition, climatic hazards that induced families' out-migration were inter-linked between climate change and non-climatic change like changes in land use, land cover and vegetations. For instance, the grazing land had been converted into agricultural land because of population increase and the quest to increase production that dwindled because of drought and changes in rainfall patterns. This implies that families migrated in search of agricultural and grazing land, in addition to water for domestic use.

In agro-pastoralist communities like in Meatu and Iramba, wealth is stored in livestock [29], which can be exchanged for food or income to buy food and other necessities so as to sustain the families. Therefore, families did all the needful to ensure that livestock did not perish because of lack of pasture and water. On one hand, migration was a coping strategy, but on

the other hand, it was an adaptation strategy for families that had practiced it for many decades. When the entire family moved, mobility increased household vulnerability for food insecurity and famine because families lost time for a long distance migration instead of dealing with livelihoods activities like farming. Migration also disturbed livelihoods natural resource base thus increased communities' vulnerability, more so among women, elderly and children who are more vulnerable. Sometimes, men alone moved out seasonally with or without livestock. This was justified by one FGD participant at Mwashata as follows:

> *"…in 2006, I moved through different districts to sustain my cattle because of lack of pasture… the districts were Bariadi, Maswa, Kwimba, Geita, Misungwi, and Shinyanga rural…during these movements four cattle died due to long distance, lack of water and pasture and the fact that they were old…" (Men FGDs participant aged 61 at Mwashata, Meatu, March 2015)*

Based on that quotation, it can be deduced that the 2006 was a famine year with inadequate pasture and food insecurity. When men moved without livestock, the main agenda was to sell labor in different villages and towns. This had been practiced for many years and so qualifying to become an adaptation strategy if it were anticipated and planned. Going for artisanal mining in mining areas in the country like Geita, Kahama and Mwadui, especially among men and youth was also reported. Men's movements to sell labor for food and income was supported by an improvement in rural roads infrastructure in the 2000s implying less vulnerability among communities relative to the period before the 2000s. However, vulnerability among women, children and the elderly who remained at home did not decrease concomitantly. It is the women who had to feed, in addition to domestic chores, the family members remained behind through skipping some meals, reducing amount or the number of meals from say three to one, and depending on wild food and fruits. Women FGD participants at Kidaru justified by reporting that:

> *"…in 2009, we survived by eating wild fruits called 'Mahama'…we collected these wild fruits in the mid night, so we used to go in the bush during the night because if you wait until morning you may be competing with baboons because they also eat them…" (Women FGDs participants, Kidaru, March 2015).*

That quotation implies that climate change had affected not only humans, but also wild animals such that wild animals and humans, especially women who had limited control over livelihoods resources and limited mobility shared similar wild food. In addition, FGDs reported that women survived by being re-marrying to another men or opting "sex for money" to buy food or "sex for food" when their husbands were away. Being forced by the circumstance to re-marry or succumbing to "sex for money" or "sex for food" increased number of sexual partners among women. This suggests increased chances of succumbing to sexual transmitted infections (STIs) including HIV/AIDS. It also implies that sexual practicing among women, when husbands were away, was a coping strategy. It appears that one of the major adaptation strategies for men was movement with or without livestock. Some did not get back or remit money back home. While taking livestock to conserved areas during pasture crisis was a coping or an adaptation strategy to climate change impact, it was a vulnerability

factor among women and children, and also created pressure on biodiversity because of concentration of livestock in the conserved areas.

Reflections in FGDs showed that communities received food aid from the local governments and non-governmental organizations particularly World Vision Tanzania during food insecurity months. Food relief seemed to increase in the previous 15 years, in which was provided almost each year. This is translated to increased climatic hazards like droughts that affected crop productivity. Some women relied on doing small scale businesses, food and money borrowing from relatives and friends in coping with droughts, food insecurity and famine. Borrowing had increased in the previous 20 years. This is not new, but borrowers returned without interest in the past, suggesting strong social capital and a culture of self-help in the communities in the past. However, FGDs commented that an interest had been introduced since the 1990s following increasing incidence of food borrowing largely due to re-occurrences of crop failure and famine. This implies that climatic hazards had weakened social networks and trust in the communities and that it had increased vulnerability among borrowers, in most cases, women who borrowed when men were away. Reflections in FGDs showed that, while men could get some money and food for selling labor when they were away from their families, it was a challenge for women, who left at home, to support family members through small scale businesses without proper skills and also through "sex for money and food." The strategies adopted by women were not reliable and sustainable given that they prevailed during hardship periods in terms of food insecurity, famine and lack of income, in which everybody in the community including men, who contracted "sex for food" and or "sex for money" with women, was a victim.

5. Conclusions and policy recommendations

Climatic hazards have complex and overlapping outcomes in semi-arid environment in Tanzania. They have negative impact on natural, social, financial, physical and human capitals that are critical for community livelihoods. The trends of the hazards had increased over time, in the previous 30 years, concurrently with famine and disturbances on communities' livelihoods. Communities, men and women, had differently adopted coping and adaptation measures in dealing with vulnerability. Men's strategies took place outside the home while women's strategies were mainly conducted at home. The major coping and adaptation strategies for men were related to mobility. Interestingly, women's adaptation and coping strategies were not reliable and sustainable such that they were not effectively working resulting into more vulnerability among women relative to men counterparts. These results have policy implications calling concerted efforts from development actors to address the situation. To that effect, the chapter recommends the following:

- Development programmes implemented by different stakeholders like the central and local governments should make sure that women are given skills and involved in environmental management interventions like tree planting, water projects and soil moisture and fertility conservation because they are main users and agents of environmental management. This can rehabilitate the degraded land to improve food security.

It can also restore availability of firewood to women's proximity that in turn reduces gender vulnerability.

- Strategies to deal with diseases like malaria and cholera as well as crop and livestock insect pests and diseases should be integrated in the development planning at local government level because it was difficult to predict the hazards like floods and droughts that occurred concomitantly with the diseases. Children, women and elderly should be given special attention because they have special health needs.
- Local governments should put in place sustainable nutrition programmes to address food insecurity and famine among women and children especially during food and income insecurity periods. Women should also be given skills and credit support to start and manage tangible small scale businesses. They should also be imparted knowledge regarding HIV/AIDS and other STIs that seemed to increase vulnerability among them.
- Suggested by FGD participants, the central government can intervene through supporting irrigated farming, tree planting, construction of water reservoirs, support in terms of drugs and experts in village dispensaries, drugs and extension officers for crops and livestock, and price control mechanism especially for cotton, which seemed to be unstable influenced by private buyers. In addressing vulnerability, the strategies should be gender sensitive because vulnerability is differentiated by gender lines. Those strategies are critical in improving and making community livelihoods sustainable with potential to addressing vulnerability to climate change as well as vulnerability to non-climatic hazards, which are mainly driven by poor communities' livelihoods. In this case, any strategy to address any kind of vulnerability should put community livelihoods at the center and so "livelihood centered approach' in addition to restoration of natural resource base.

Acknowledgements

This study was conducted under the auspices of the Enhancing Pro-Poor Innovations in Natural Resources and Agricultural Value Chains (EPINAV) Programme, which was implemented by Sokoine University of Agriculture for the period between 2011 and 2016. The author is therefore thankful for financial support from EPINAV without which the study could not have been possible. Many thanks are also extended to the smallholder farmers and agro-pastoralists in the villages of Mwashata, Mwamanimba and Kidaru for the valuable information shared and time spent during Focus Group Discussions.

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References

[1] Nombo CI, Urassa JK, Mbwambo JS, Mattee AZ, Mamiro DP, Kabote SJ, Matata L, Synnevåg G. A gendered analysis of climate change impacts and adaptations in semi-arid area farming systems of Tanzania. Journal of Continuing Education and Extension. 2013;**4**(1):212-227

[2] O'brien K, Eriksen S, Nygaard LP, Schjolden A. Why different interpretations of vulnerability matter in climate change discourses. Climate Policy. 2007;**7**:73-88

[3] Coletti A, Howe PD, Yarnal B, Wood NJ. A support system for assessing local vulnerability to weather and climate. Natural Hazards. 2013;**65**:999-1008. DOI: 10.1007/s11069-012-0366-3

[4] Intergovernmental Panel on Climate Change (IPCC). Summary for Policy Makers. In: Parry ML, Canziani OF, Palutikof JP, Van der Linden PJ, Hanson CE, editors. Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge: Cambridge University Press; 2007. pp. 7-22

[5] Kelly PM, Adger WN. Theory and practice in assessing vulnerability to climate change and facilitating adaptation. Climatic Change. 2000;**47**:325, 2000-352

[6] Schilderinck G. Drought Cycle in Arid and Semi-arid Kenya: A Relevant Disaster Reduction Model? The Hague: Catholic Organisation for Relief and Development Aid; 2009. 49 pp

[7] Dazé A. Understanding Vulnerability to Climate Change: Insights from Application of CARE's Climate Vulnerability and Capacity Analysis. Niger: CARE Poverty, Environment and Climate Change Network; 2011. 24 pp

[8] Mulinge MM, Getu M. Impacts of Climate Change and Variability on Pastoralist Women in Sub-Saharan Africa (editors). Kampala: Fountain Publishers; 2013

[9] Intergovernmental Panel on Climate Change (IPCC). Climate Change 2014: Impacts, Adaptation, and Vulnerability. In: Field C, Barros V, Mach K, Mastrandrea M, editors. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge: Cambridge University Press; 2014

[10] Mamiro DP, Kabote SJ, Urassa JK, Masolwa LW, Nombo CI, Matte AZ, Synnevåg G, Mbwambo JS. The effects of climate variability and change to the farming systems in Iramba and Meatu districts, Tanzania. Journal of Continuing Education and Extension. 2014;**5**(2):652-670

[11] Dazé A, Ambrose K, Ehrhart C. Climate Vulnerability and Capacity Analysis Handbook. CARE. 2009. 43 pp. Accessed from www.careclimatechange.org on 24-07-2014

[12] Lorber J. Gender Inequality: Feminist Theories and Politics. Oxford: Oxford University Press; 2010

[13] Denton F. Climate Change Vulnerability, Impacts, and Adaptation: Why Does Gender Matter? Gender and Development. 2002;**10**(2):10-20

[14] Fulu E. Gender, vulnerability, and the experts: responding to the Maldives Tsunami. Development and Change. 2007;**38**(5):843-864

[15] Arora-Jonsson S. Virtue and vulnerability: discourses on women, gender and climate change. Global Environmental Change. 2011;**21**:744-751

[16] Djoudi H, Brockhaus M. Is adaptation to climate change gender neutral? Lessons from communities dependent on livestock and forests in northern Mali. International Forestry Review. 2011;**13**(2):123-135

[17] Chambers R, Conway G. Sustainable Rural Livelihoods: Practical Concepts for the 21st Century. IDS Discussion Chapter 296. Brighton: IDS; 1992

[18] Scoones I. Livelihoods perspectives and rural development. Journal of Peasant Studies. 2009;**36**(1):71-196. DOI: 10.1080/03066150902820503

[19] Flora CB. Community, climate change, and sustainable intensification: why gender is important. In: Lal R, Singh BR, Mwaseba DL, Kraybill D, Hansen DO, Eik LO, editors. Sustainable Intensification to Advance Food Security and Enhance Climate Resilience in Africa. Switzerland: Springer International Publishing; 2015. pp. 515-531

[20] Department for International Development (DFID). Sustainable Livelihoods Guidance Sheets. London, U.K.: DFID; 1992

[21] Meatu District Council. Meatu District Socio-Economic Profile. Mwanhuzi: Meatu District Council; 2009. 89 pp

[22] Iramba District Council. Iramba District Socio-Economic Profile. Kiomboi: Iramba District Council; 2009. 10 pp

[23] Rubanza CDK, Shem MN, Bakengesa SS, Ichinohe T, Fujiyama T. Content of macro and micro minerals of deferred forages in silvo-pastoral traditional fodder banks (Ngitiri) of Meatu District of central north-western Tanzania. Livestock Research for Rural Development. 2005;**17**(12). http://www.lrrd.org/lrrd17/12/ruba17141.htm retrieved on 22/07/2017

[24] Kabote SJ, Mamiro D, Synnevåg G, Urassa JK, Mattee AZ, Mbwambo JS, Nombo CI, Masolwa LW, Chingonikaya EE. Inter-annual anomaly and seasonal variability of rainfall and temperature in selected semi-arid areas of Tanzania. Journal of Continuing Education and Extension 2013;**4**(2):295-317

[25] Chambers R. Participatory rural appraisal: analysis of experience. World Development. 1994;**22**(9):1253-1268

[26] Creswell JW. Research Design: Qualitative, Quantitative and Mixed Method Approaches. 2nd ed. Thousand Oaks: International Educational and Professional Publisher; 2003. 26 pp

[27] Masadeh MA. Focus group: reviews and practices. International Journal of Applied Science and Technology. 2012;**2**(10):63-68

[28] United Republic of Tanzania (URT). National Policy of Youth Development. Ministry of Labour, Employment and Development. Dar es Salaam. 2007. Accessed: 07-12-2017 at http://www.youthpolicy.org/national/Tanzania_2007_National_Youth_Policy.pdf

[29] Synneva G, Kabote SJ, Nombo CI, Mamiro DP, Mattee AZ. Smallholder adaptation to climate change in semi-arid areas of Tanzania: experiences from Iramba and Meatudistricts. In: Lal R, Singh BR, Mwaseba DL, Kraybill D, Hansen DO, Eik LO, editors. Sustainable Intensification to Advance Food Security and Enhance Climate Resilience in Africa. Springer International Publishing, Switzerland. 2015. pp. 467-485